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(54) Abstract Title

Digital/Analog and PCS mode portable telephone

(57) A radio signal processing apparatus for a portable telephone capable of operating in D/A and PCS (Portable Communication Service) modes. A D/A compatible converter 212 converts the frequency of signals transmitted and received in the D/A mode from or into transmitting and receiving intermediate frequencies (Ifs) respectively. A PCS converter 210 does the same for signals transmitted and received in the PCS mode. An IF processor 214 converts the transmitting and receiving intermediate frequencies from or into baseband frequencies and switching means 218, 220, 222 connect an antenna 216 of the portable telephone and the IF processor 214 to the D/A compatible converter 212 or the PCS converter 210 according to a mode selection signal.

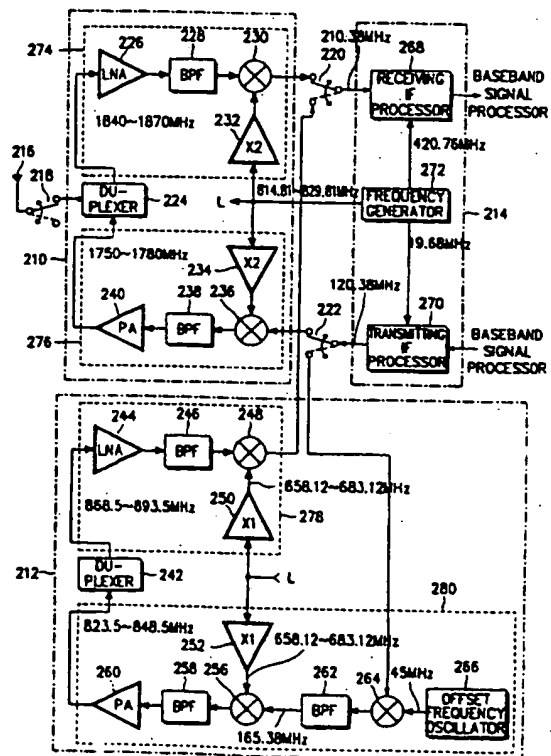


FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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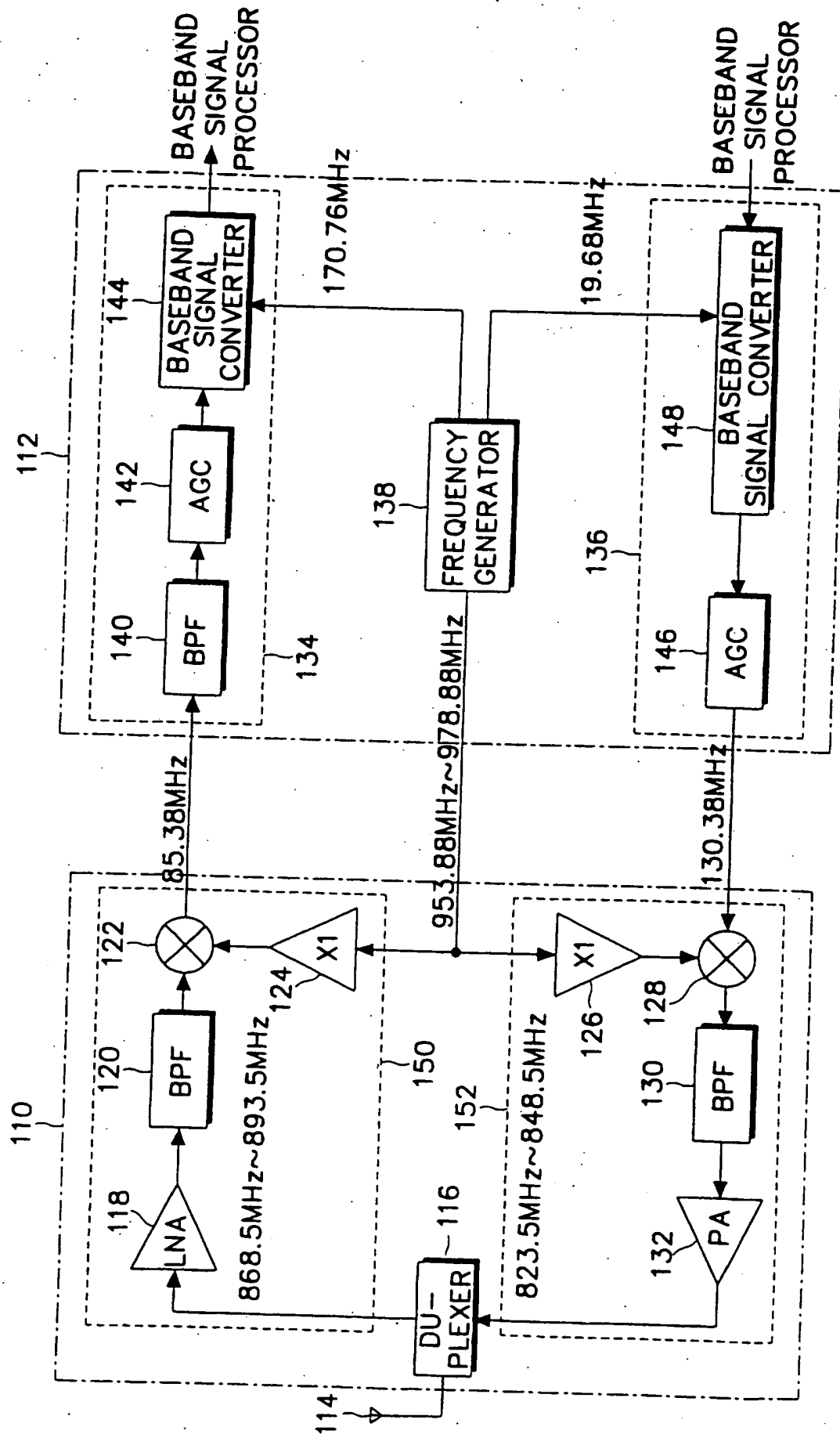


FIG. 1

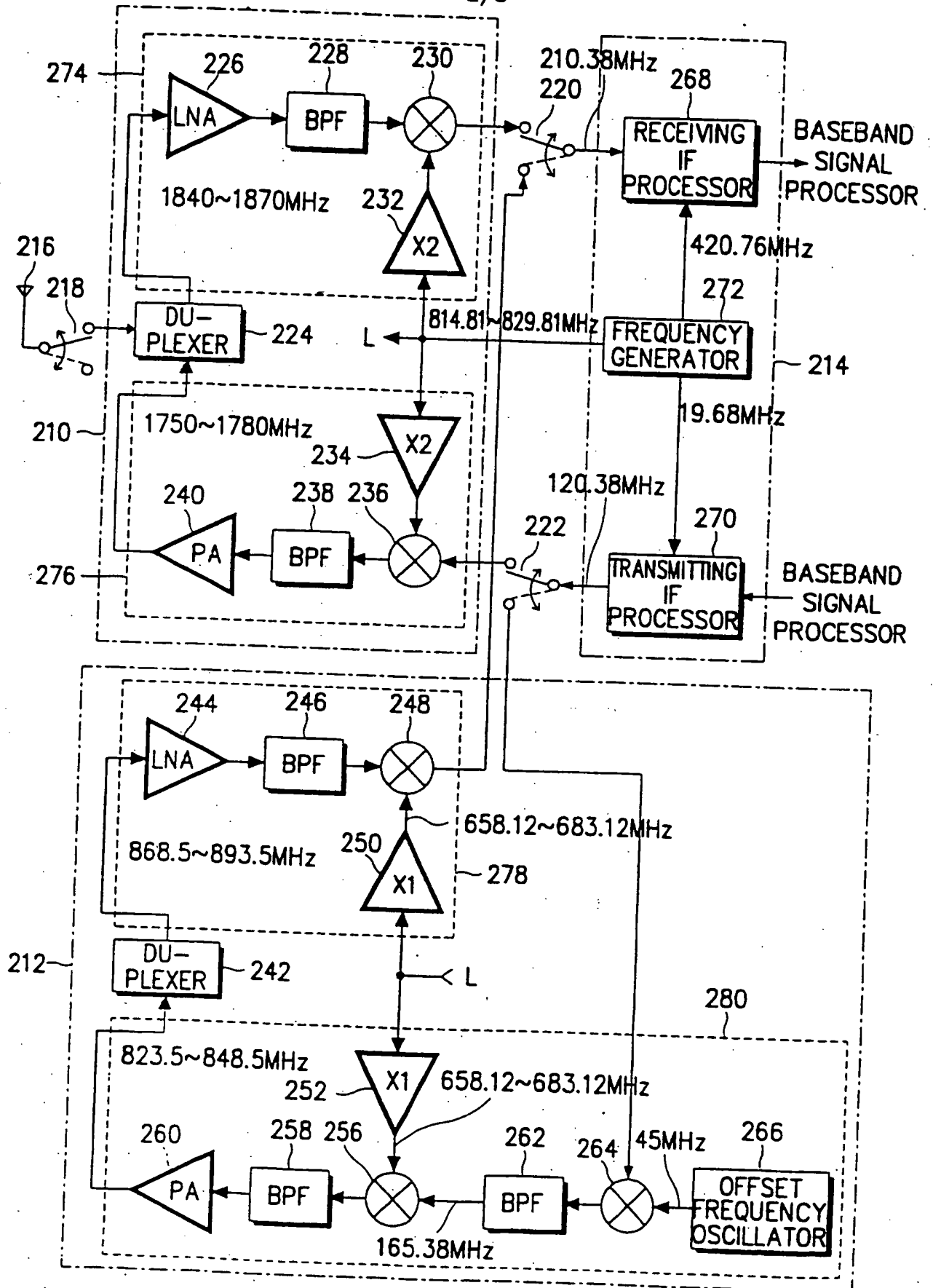


FIG. 2

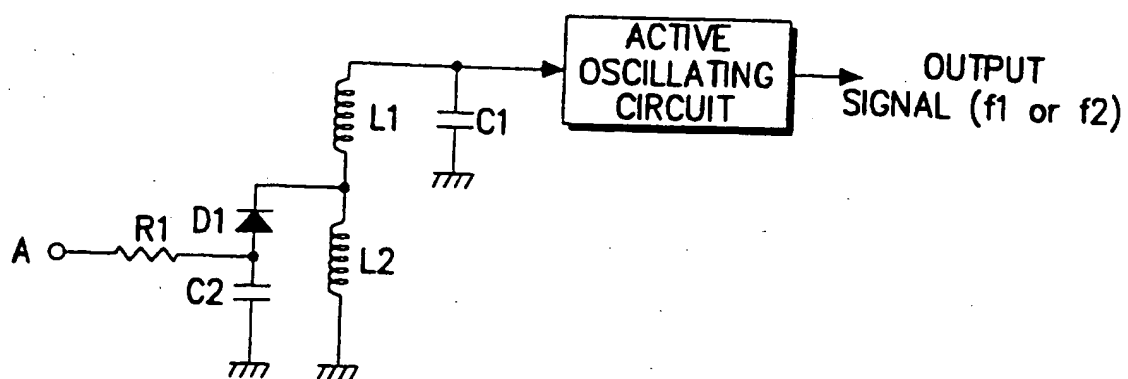


FIG. 3

DIGITAL/ANALOG AND PCS MODE PORTABLE TELEPHONE

BACKGROUND OF THE INVENTION

- 5 The present invention relates to a radio signal processing apparatus for a portable telephone that can operate in a cellular digital/analog compatible mode and a personal communication service mode.
- 10 A personal communication service (PCS) is a mobile communication service and provides a radio service within a service area by processing a part of regionally fixed subscriber lines by radio. To use a portable telephone in a digital/analog compatible mode, a radio signal processing
- 15 apparatus has been proposed as shown in Fig. 1. The digital/analog compatible mode is a new standard (IS-95; TR-45) in which an analog system is compatible with a digital system. The digital/analog compatible standard IS-95 specifies that a frequency bandwidth assigned to an
- 20 analog cellular telephone can be used in a code division multiple access (CDMA) digital system. Therefore, the radio signal processing apparatus of Fig. 1 can be used in both the digital system and the analog system. The receiving and transmitting frequency ranges used in the radio signal
- 25 processing apparatus are 868.5-893.5 MHz and 823.5-848.5 MHz, respectively.

Referring to Fig. 1, the radio signal processing apparatus of the digital/analog compatible portable telephone

30 includes a digital/analog compatible converter 110, an intermediate frequency (IF) signal processor 112 and an antenna 114. The digital/analog compatible converter 110 transmits or receives a signal in tune with a frequency band of 800 MHz. The IF signal processor 112 generates an

35 IF signal used in the radio processing apparatus of the digital/analog compatible portable telephone or processes a signal transmitted to or received from the digital/analog compatible converter 110.

The digital/analog compatible converter 110 which is tuned with the frequency band of 800 MHz includes a duplexer 116, a digital/analog compatible receiving signal converter 150 having a low-noise amplifier (LNA) 118, a band pass filter (BPF) 120, a receiving mixer 122 and a multiplier 124, and a digital/analog compatible transmitting signal converter 152 having a multiplier 126, a transmitting mixer 128, a band pass filter 130 and a power amplifier (PA) 132. The IF signal processor 112 has a receiving IF processor 134, a frequency generator 138 and a transmitting IF processor 136.

In operation, a received signal of the frequency band of 800 MHz received through the antenna 114 is transmitted to the low-noise amplifier 118 through the demultiplexer 116. The receiving signal is low-noise amplified through the low-noise amplifier 118 and band pass filtered through the band pass filter 120 having a pass band of 868.5-893.5 MHz. The output of the band pass filter 120 is mixed with a local oscillating signal through the receiving mixer 122. The local oscillating signal is obtained by multiplying the frequency of an oscillating signal VCO generated from the frequency generator 138 of the IF signal processor 112 by one by a fundamental wave oscillating summing process through the multiplier 124. The oscillating signal VCO generated from the frequency generator 138 has an oscillating frequency $f(\text{VCO})$ of 953.88-978.88 MHz. The local oscillating signal generated from the multiplier 124 has the same frequency as the oscillating signal VCO generated from the frequency generator 138.

Therefore, the receiving mixer 122 mixes the received signal having the frequency of 868.5-893.5 MHz with the local oscillating signal having the frequency of 953.88-978.88 MHz and generates an IF signal having a frequency of 85.38 MHz. The IF signal having the frequency of 85.38 MHz generated from the receiving mixer 122 is band pass filtered through a band pass filter 140 of the receiving IF processor 134 of the IF signal processor 112. The band pass

filtered IF signal is gain-controlled through an automatic gain controller (AGC) 142. The gain-controlled IF signal is converted into an analog signal through a baseband signal converter 144 by a signal having the frequency of 170.76 MHz generated from the frequency generator 138 and then transmitted to a baseband signal processor.

The operation of transmitting a transmitting IF signal is performed in reverse order. A baseband signal converter 148 of the transmitting IF processor 136 converts a baseband analog signal received from the baseband signal processor into a transmitting IF signal by using a signal having a frequency of 19.68 MHz generated from the frequency generator 138 and a signal of a frequency of 260.76 MHz. The transmitting IF signal is gain-controlled through an automatic gain controller 146 to generate an IF signal having a frequency of 130.38 MHz.

The IF signal having the frequency of 130.38 MHz is transmitted to the transmitting mixer 128 of the digital/analog compatible converter 110. The transmitting mixer 128 mixes the IF signal of 130.38 MHz with a local oscillating signal of a frequency of 953.88-978.88 MHz generated from the multiplier 126 and generates a transmitting signal having a frequency of 823.5-848.5 MHz. The local oscillating signal is generated through the same process as the local oscillating signal used in the receiving mixer 122 and will therefore not be described in detail. The transmitting signal is band pass filtered through the band pass filter 130 having a pass band of 823.5-848.5 MHz and power-amplified through the power amplifier 132. The power-amplified transmitting signal is transmitted to the duplexer 116 and radiated through the antenna 114.

As described above, the receiving and transmitting frequency ranges used in the digital/analog compatible portable telephone are 868.5-893.5 MHz and 823.5-848.5 MHz, respectively. However, the receiving and transmitting

frequency ranges used in the PCS portable telephone are 1840-1870 MHz and 1750-1780 MHz, respectively. Since there is a great difference in the receiving and transmitting frequency ranges between the PCS portable telephone and the digital/analog compatible portable telephone, it is difficult to share a single radio signal processing apparatus. That is, the frequency receiving and transmitting frequency ranges used in the PCS portable telephone are two or more times the receiving and transmitting frequency ranges used in the digital/analog compatible portable telephone. Therefore, to achieve a portable telephone which can operate in the frequency bands used in the digital/analog compatible mode and the PCS mode, respective radio signal processing apparatus must be provided. Hence, the size of the portable telephone is increased.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved radio signal processing apparatus which can operate in a digital/analog compatible mode and a PCS mode.

According to the present invention, there is provided a radio signal processing apparatus for a portable telephone capable of operating in a digital/analog (D/A) compatible mode and a PCS (PCS) mode, comprising:

- a frequency generator for generating frequency conversion frequencies;

- a D/A compatible converter for converting the frequency of signals transmitted and received in the D/A compatible mode from or into transmitting and receiving intermediate frequencies (IFs) respectively according to one of the said frequency conversion frequencies;

- a PCS converter for converting the frequency of signals transmitted and received in the PCS mode from or into transmitting and receiving intermediate frequencies respectively according to one of the said frequency conversion frequencies;

- an IF processor for converting the transmitting and

receiving intermediate frequencies from or into baseband frequencies according to one of the said frequency conversion frequencies;

switching means for connecting an antenna of the portable telephone and the IF processor to the D/A compatible converter or the PCS converter according to a mode selection signal.

Preferably, the switching means comprises:

10 a first switch for connecting the antenna to the D/A compatible converter or the PCS converter; and

a second switch for connecting the IF processor to the D/A compatible converter or the PCS converter.

15 Preferably, the D/A compatible converter comprises:

a first duplexer for transmitting or receiving a signal to or from the first switch;

a D/A compatible receiving signal converter for converting a signal received through the first duplexer into an IF signal and supplying the IF signal to the second switch; and

20 a D/A compatible transmitting signal converter for converting an IF signal received through the second switch into a transmitting signal and supplying the transmitting signal to the first switch.

Preferably, the D/A compatible receiving signal converter comprises:

a first low-noise amplifier for low-noise amplifying the signal received through the first duplexer;

30 a first band pass filter for filtering the low-noise amplified signal;

a first multiplier for multiplying a first frequency conversion frequency from the frequency generator by one to generate a first local oscillating signal; and

35 a first mixer for mixing the first band pass filtered signal with the first local oscillating signal to generate an IF signal.

Preferably, the D/A compatible transmitting signal converter comprises:

a second multiplier for multiplying the first frequency conversion frequency from the frequency generator
5 by one to generating a second local oscillating signal;

an offset frequency oscillator for generating an offset frequency;

a second mixer for mixing an IF signal from the second switch with the offset frequency;

10 a second band pass filter for filtering the output of the second mixer;

a third mixer for mixing the second local oscillating signal with the output of the second band pass filter to generate a transmitting signal;

15 a third band pass filter for filtering the output of the third mixer; and

a first power amplifier for power-amplifying the output of the third band pass filter and supplying the power-amplified signal to the first duplexer.

20

Preferably, the PCS converter comprises:

a second duplexer for transmitting or receiving a signal to or from the first switch;

a PCS receiving signal converter for converting a
25 signal received through the second duplexer into an IF signal and supplying the IF signal to the second switch; and

a PCS transmitting signal converter for converting an IF signal received through the second switch into a
30 transmitting signal and supplying the transmitting signal to the first switch.

Preferably, the second switch comprises:

a third switch for connecting the D/A compatible
35 receiving signal converter or the PCS receiving signal converter to the IF processor according to the mode selection signal; and

a fourth switch for connecting the D/A compatible transmitting signal converter or the PCS transmitting

signal converter to the IF processor according to the mode selection signal.

Preferably, the PCS receiving signal converter comprises:

- 5 a second low-noise amplifier for low-noise amplifying a signal received through the second duplexer;
- a fourth band pass filter for filtering the second low-noise amplified signal;
- a third multiplier for doubling the first frequency
- 10 conversion frequency from the frequency generator to generate a third local oscillating signal; and
- a fourth mixer for mixing the output of the fourth band pass filter with the third local oscillating signal to generate an IF signal.

15

Preferably, the PCS transmitting signal converter comprises:

- a fourth multiplier for doubling the first frequency
- 20 conversion frequency from the frequency generator to generate a fourth local oscillating signal;
- a fifth mixer for mixing an IF signal from the second switch with the fourth local oscillating signal to generate a second transmitting signal;
- a fifth band pass filter for filtering the second
- 25 transmitting signal; and
- a second power amplifier for power-amplifying the output of the fifth band pass filter and supplying the power-amplified signal to the second duplexer.

30 BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described by way of example with reference to the accompanying drawings in which:

Fig. 1 is a block diagram of a conventional radio

35 signal processing apparatus of a digital/analog compatible portable telephone;

Fig. 2 is a block diagram of a radio signal processing apparatus according to the present invention; and

Fig. 3 shows a general oscillating circuit including

an oscillating band resonator.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With the current trend towards complex systems in mobile
5 radio communication products, a new terminal which combines
a cellular portable telephone using a frequency band of
800-900 MHz with a PCS portable telephone using the
frequency band of 1.8 GHz has been demanded. Moreover, as
electronic products tend to reduce in size, a small-sized
10 terminal which can operate in a digital/analog compatible
mode and a PCS mode has been demanded. In a portable
telephone which uses different frequencies and operates in
the two modes, most of the apparatus except the radio
signal processing apparatus can be shared. Therefore, to
15 achieve a small-sized portable telephone, it is important
to reduce the size of the radio signal processing apparatus
for detecting and reproducing the different frequencies.

Referring to Fig. 2, the radio signal processing apparatus
20 includes a PCS converter 210, a digital/analog compatible
converter 212, an IF signal processor 214, an antenna 216,
and switches 218, 220 and 222. The PCS converter 210
transmits or receives a signal transmitted or received when
using a PCS in tune with a frequency band of 1.8 GHz. The
25 digital/analog compatible converter 212 transmits or
receives a signal transmitted or received when using a
cellular communication system in tune with a frequency band
of 800 MHz. The IF signal processor 214 generates an IF
signal used in the radio signal processing apparatus of the
30 portable telephone which can operate in a digital/analog
compatible mode and a PCS mode. The IF signal processor 214
also processes signals transmitted to and received from the
PCS converter 210 and the digital/analog compatible
converter 212.

35

The first to third switches 218, 220 and 222 connect lines
according to the demand of a user. The first switch 218
connects the antenna 216 to the PCS converter 210 or the
digital/analog compatible converter 212. The second switch

- 220 transmits a received IF signal from the PCS converter 210 or a received IF signal from the digital/analog compatible converter 212 to a receiving IF input terminal of the IF signal processor 214. The third switch 222
 5 transmits a transmitting IF signal from the IF signal processor 214 to a transmitting IF input terminal of the PCS converter 210 or the digital/analog compatible converter 212.
- 10 The PCS converter 210 tuned with the frequency band of 1.8 GHz includes a duplexer 224, a PCS receiving signal converter 274 having a low-noise amplifier (LNA) 226, a band pass filter (BPF) 228, a receiving mixer 230 and a multiplier 232 and a PCS transmitting signal converter 276
 15 having a multiplier 234, a transmitting mixer 236, a band pass filter 238 and a power amplifier (PA) 240. The digital/analog compatible converter 212 tuned with the frequency band of 800 MHz includes a duplexer 242, a digital/analog compatible receiving signal converter 278
 20 having a low-noise amplifier 244, a band pass filter 246, a receiving mixer 248 and a multiplier 250 and a digital/analog compatible transmitting signal converter 280 having a multiplier 252, a transmitting mixer 256, a power amplifier 260, a mixer 264, band pass filters 258 and 262
 25 and an offset frequency oscillator 266. The IF signal processor 214 consists of a receiving IF processor 268, a frequency generator 272, and a transmitting IF processor 270.
- 30 The transmitting/receiving operation when the user has selected the PCS mode will now be described. If the PCS mode is selected, the first switch 218 is switched to connect the antenna 216 to the PCS converter 210. A received signal of the frequency band of 1.8 GHz received
 35 through the antenna 216 is transmitted to the duplexer 224 of the PCS converter 210 and low-noise amplified through the low-noise amplifier 226. The amplified signal is band pass filtered through the band pass filter 228 having a pass band of 1840-1870 MHz. The output of the band pass

filter 228 is mixed with a local oscillating signal through the receiving mixer 230.

The local oscillating signal is obtained by doubling the
5 frequency of an oscillating signal VCO generated from the frequency generator 272 of the IF signal processor 214 through the multiplier 232. The oscillating signal VCO generated from the frequency generator 272 has an oscillating frequency $f(\text{VCO})$ of 814.81-829.81 MHz.
10 Therefore, the local oscillating signal generated from the multiplier 232 has a frequency $f(\text{LO})$ of 1629.62-1659.62 MHz. The receiving mixer 230 generates a signal having as its frequency the difference between the received signal and the local oscillating signal frequencies. That is, the
15 receiving mixer 230 mixes the received signal having a frequency band of 1840-1870 MHz with the local oscillating signal having a frequency band of 1629.62-1659.62 MHz and generates an IF signal having a frequency of 210.38 MHz. The second switch 220 is switched to connect the PCS
20 converter 210 to the IF signal processor 214 by the selection of the PCS mode. Therefore, the IF signal having the frequency of 210.38 MHz from the receiving mixer 230 is transmitted to the receiving IF processor 268 of the IF signal processor 214. The IF signal transmitted to the
25 receiving IF processor 268 is band pass filtered, gain-controlled, converted into an analog signal by a signal having the frequency of 420.76 MHz from the frequency generator 272, and transmitted to a baseband signal processor.

30

The operation for transmitting a transmitting IF signal is performed in reverse order. The transmitting IF processor 270 converts a baseband analog signal received from the baseband signal processor into a transmitting IF signal by
35 using a signal having the frequency of 19.68 MHz from the frequency generator 272 and a signal of 240.76 MHz. The transmitting IF signal is gain-controlled to generate an IF signal having a frequency of 120.38 MHz. The third switch 222 is switched to connect the transmitting IF processor

270 of the IF signal processor 214 to the PCS converter 210. Hence, the IF signal having a frequency of 120.38 MHz from the transmitting IF processor 270 is transmitted to the transmitting mixer 236 of the PCS converter 210.

5

The IF signal is mixed with a local oscillating signal through the transmitting mixer 236. The local oscillating signal is obtained by doubling the frequency of the oscillating signal VCO generated from the frequency generator 272 of the IF signal processor 214 through the multiplier 234. The oscillating signal VCO generated from the frequency generator 272 has an oscillating frequency $f(\text{VCO})$ of 814.81-829.81 MHz. Therefore, the local oscillating signal generated from the multiplier 234 has a frequency $f(\text{LO})$ of 1629.62-1659.62 MHz. The transmitting mixer 236 generates a signal having the sum frequency of the transmitting IF signal and the local oscillating signal. That is, the transmitting mixer 236 mixes the transmitting IF signal having the frequency of 120.38 MHz with the local oscillating signal having the frequency of 1629.62-1659.62 MHz and generates a transmitting signal having a frequency of 1750-1780 MHz. The transmitting signal is band pass filtered through the band pass filter 238 having a pass band of 1750-1780 MHz and then power-amplified through the power amplifier 240. The output of the power amplifier 240 is transmitted to the duplexer 224. The signal transmitted to the duplexer 224 is transmitted to the antenna 216 via the first switch 218 and radiated through the antenna 216.

30

The transmitting/receiving operation when the user selects the digital/analog cellular mode will now be described. If the digital/analog cellular mode is selected, the first switch 218 connects the antenna 216 to the digital/analog compatible converter 212. A received signal of the frequency band of 800 MHz received through the antenna 216 is transmitted to the duplexer 242 of the digital/analog compatible converter 212 and low-noise amplified through the low-noise amplifier 244. The amplified signal is band

35

pass filtered through the band pass filter 246 having a pass band of 868.5-893.5 MHz. The output of the band pass filter 246 is mixed with a local oscillating signal through the receiving mixer 248.

5

The local oscillating signal is obtained by multiplying the frequency of the oscillating signal VCO from the frequency generator 272 of the IF signal processor 214 by one through the multiplier 250. The oscillating signal frequency $f(\text{VCO})$ of 814.81-829.81 MHz is changed to an oscillating signal frequency $f(\text{VCO2})$ of 658.12-683.12 MHz by a resonance circuit shown in Fig. 3.

Referring to Fig. 3, there is illustrated one example of a circuit for changing the oscillating signal frequency $f(\text{VCO})$ of 814.81-829.81 MHz to an $f(\text{VCO2})$ of 658.12-683.12 MHz. Fig. 3 is a known technique and shows an oscillating circuit including an oscillating band resonator. If a signal A of logic "high" is supplied, a diode D1 is turned on. If a capacitor C2 has a very large capacitance, a node N becomes nearly ground potential since impedance is negligible with respect to an alternating current (AC) signal of the frequency to be oscillated. Therefore, inductor L2 can be disregarded.

25

The resonator consisting of an inductor L1 and a capacitor C1 resonates at a frequency f_1 expressed as follows:

$$f_1 = \frac{1}{2\pi\sqrt{L_1 \times C_1}} \dots\dots\dots (1)$$

30

If the signal A of logic "low" is supplied, the diode D1 is turned off. Then a circuit toward the capacitor C2 is opened and the node N is not AC ground state. The resonator is constructed of inductors L1 and L2 and capacitor C1 and resonates at a frequency f_2 expressed as:

35

$$f_2 = \frac{1}{2\pi\sqrt{(L_1+L_2) \times C_1}} \dots\dots\dots (2)$$

Therefore, two difference frequencies can be generated by the oscillating circuit including the oscillating band resonator of Fig. 3.

The oscillating signal from the frequency generator 272 has a frequency of 658.12-683.12 MHz, and the local oscillating signal from the multiplier 250 also has a frequency of 658.12-683.12 MHz. The receiving mixer 248 mixes the received signal of 868.5-893.5 MHz with the local oscillating signal having a frequency of 658.12-683.12 MHz and generates the IF signal having the frequency of 210.38 MHz. The second switch 220 is switched to connect the digital/analog compatible converter 212 to the IF signal processor 214 by the selection of the digital/analog cellular mode. Therefore, the IF signal having the frequency of 210.38 MHz generated from the receiving mixer 248 is transmitted to the receiving IF processor 268 of the IF signal processor 214. The IF signal transmitted to the receiving IF processor 268 is identically processed to the operation implemented in the PCS mode.

Meanwhile, the transmitting operation of the transmitting IF processor 270 performed in the digital/analog cellular mode is identical to that carried out in the PCS mode. The third switch 222 is switched to connect the transmitting IF processor 270 of the IF signal processor 214 to the digital/analog compatible converter 212. Hence, the IF signal having the frequency of 120.38 MHz generated from the transmitting IF processor 270 is transmitted to the mixer 264 of the digital/analog compatible converter 212. The mixer 264 mixes the transmitted IF signal with the output of the offset frequency oscillator 266 and generates a transmitting IF signal necessary for the digital/analog cellular mode. The IF signal transmitted through the third switch 222 has a frequency of 120.38 MHz and the output of

the offset frequency oscillator 266 has a frequency of 45 MHz. The transmitting IF frequency signal from the mixer 264 has a frequency of 165.38 MHz.

- 5 The transmitting IF signal generated from the mixer 264 is band pass filtered through the band pass filter 262 and mixed with a local oscillating signal through the transmitting mixer 256. The local oscillating signal is obtained through the same process as the signal used in the
- 10 receiving mixer 248. The transmitting mixer 256 mixes the transmitting IF signal of 165.38 MHz with the local oscillating frequency of 658.12-683.12 MHz and generates a transmitting signal having a frequency of 823.5-848.5 MHz. The transmitting signal generated from the transmitting
- 15 mixer 256 is band pass filtered through the band pass filter 258 having the pass band of 823.5-848.5 MHz and power-amplified through the power amplifier 260. The output of the power amplifier 260 is transmitted to the duplexer 242. The signal transmitted to the duplexer 242 is
- 20 transmitted to the antenna 216 via the first switch 218 and radiated through the antenna 216.

- Consequently, since a common part of the radio signal processing apparatus is shared and the local oscillating
- 25 signal generated from the frequency generator is used by extracting different multiplying components, a small-sized portable telephone which can operate in digital/analog compatible mode and PCS mode can be obtained.

CLAIMS

1. A radio signal processing apparatus for a portable telephone capable of operating in a digital/analog (D/A) compatible mode and a PCS (PCS) mode, comprising:
 - 5 a frequency generator for generating frequency conversion frequencies;
 - a D/A compatible converter for converting the frequency of signals transmitted and received in the D/A compatible mode from or into transmitting and receiving intermediate frequencies (IFs) respectively according to one of the said frequency conversion frequencies;
 - 10 a PCS converter for converting the frequency of signals transmitted and received in the PCS mode from or into transmitting and receiving intermediate frequencies respectively according to one of the said frequency conversion frequencies;
 - 15 an IF processor for converting the transmitting and receiving intermediate frequencies from or into baseband frequencies according to one of the said frequency conversion frequencies;
 - 20 switching means for connecting an antenna of the portable telephone and the IF processor to the D/A compatible converter or the PCS converter according to a mode selection signal.
 - 25
2. A radio signal processing apparatus according to claim 1 in which the switching means comprises:
 - a first switch for connecting the antenna to the D/A compatible converter or the PCS converter; and
 - 30 a second switch for connecting the IF processor to the D/A compatible converter or the PCS converter.
3. A radio signal processing apparatus according to claim 2 in which the D/A compatible converter comprises:
 - 35 a first duplexer for transmitting or receiving a signal to or from the first switch;
 - a D/A compatible receiving signal converter for converting a signal received through the first duplexer

into an IF signal and supplying the IF signal to the second switch; and

a D/A compatible transmitting signal converter for converting an IF signal received through the second switch
5 into a transmitting signal and supplying the transmitting signal to the first switch.

4. A radio signal processing apparatus according to claim 3 in which the D/A compatible receiving signal converter
10 comprises:

a first low-noise amplifier for low-noise amplifying the signal received through the first duplexer;

a first band pass filter for filtering the low-noise amplified signal;

15 a first multiplier for multiplying a first frequency conversion frequency from the frequency generator by one to generate a first local oscillating signal; and

a first mixer for mixing the first band pass filtered signal with the first local oscillating signal to generate
20 an IF signal.

5. A radio signal processing apparatus according to claim 3 or claim 4 in which the D/A compatible transmitting signal converter comprises:

25 a second multiplier for multiplying the first frequency conversion frequency from the frequency generator by one to generating a second local oscillating signal;

an offset frequency oscillator for generating an offset frequency;

30 a second mixer for mixing an IF signal from the second switch with the offset frequency;

a second band pass filter for filtering the output of the second mixer;

a third mixer for mixing the second local oscillating
35 signal with the output of the second band pass filter to generate a transmitting signal;

a third band pass filter for filtering the output of the third mixer; and

a first power amplifier for power-amplifying the

output of the third band pass filter and supplying the power-amplified signal to the first duplexer.

6. A radio signal processing apparatus according to claim
5 2 in which the PCS converter comprises:

a second duplexer for transmitting or receiving a signal to or from the first switch;

a PCS receiving signal converter for converting a signal received through the second duplexer into an IF
10 signal and supplying the IF signal to the second switch;
and

a PCS transmitting signal converter for converting an IF signal received through the second switch into a transmitting signal and supplying the transmitting signal
15 to the first switch.

7. A radio signal processing apparatus according to any one of claims 3-5 in which:

the PCS converter comprises:

20 a second duplexer for transmitting or receiving a signal to or from the first switch;

a PCS receiving signal converter for converting a signal received through the second duplexer into an IF signal and supplying the IF signal to the second
25 switch; and

a PCS transmitting signal converter for converting an IF signal received through the second switch into a transmitting signal and supplying the transmitting signal to the first switch; and
30 the second switch comprises:

a third switch for connecting the D/A compatible receiving signal converter or the PCS receiving signal converter to the IF processor according to the mode selection signal; and

35 a fourth switch for connecting the D/A compatible transmitting signal converter or the PCS transmitting signal converter to the IF processor according to the mode selection signal.

8. A radio signal processing apparatus according to claim 6 or claim 7 in which the PCS receiving signal converter comprises:

5 a second low-noise amplifier for low-noise amplifying a signal received through the second duplexer;

a fourth band pass filter for filtering the second low-noise amplified signal;

10 a third multiplier for doubling the first frequency conversion frequency from the frequency generator to generate a third local oscillating signal; and

a fourth mixer for mixing the output of the fourth band pass filter with the third local oscillating signal to generate an IF signal.

15 9. A radio signal processing apparatus according to claim 7 or claim 8 in which the PCS transmitting signal converter comprises:

20 a fourth multiplier for doubling the first frequency conversion frequency from the frequency generator to generate a fourth local oscillating signal;

a fifth mixer for mixing an IF signal from the second switch with the fourth local oscillating signal to generate a second transmitting signal;

25 a fifth band pass filter for filtering the second transmitting signal; and

a second power amplifier for power-amplifying the output of the fifth band pass filter and supplying the power-amplified signal to the second duplexer.

30 10. A radio signal processing apparatus for a portable telephone capable of operating in a digital/analog (D/A) compatible mode and a PCS (PCS) mode, substantially as described with reference to and/or as illustrated in FIGs. 2 and 3 of the accompanying drawings.



Application No: GB 9725660.6
Claims searched: 1 to 10

Examiner: Glyn Hughes
Date of search: 20 April 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P): H4L (LDSC, LECX), H3Q (QDRD, QDRS)

Int CI (Ed.6): H04B 1/40, H04Q 7/32

Other: Online: WPI, INSPEC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X, P	GB 2310342 A (NORTHERN TELECOM) see whole document	1, 2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.